

**Remarks**

This Amendment is submitted in response to the outstanding Office Action wherein the Examiner rejected Claims 1-39, all the claims under consideration. Reconsideration and allowance of the application in view of the amendments submitted herewith and the following remarks is respectfully requested.

Prior to discussing the prior art rejections, Applicants take this opportunity to set forth the following brief remarks about their invention. Applicants have discovered a method for forming a splined shaft in which the advantages of aluminum alloys tempered to a T4 condition may be appreciated without experiencing the disadvantageous effects of the instability in T4 tempered alloys.

More specifically, a T4 temper aluminum alloy material is desirable from a ductility and strength standpoint for use in stamping operations. One such advantage is that it does not need to be solution annealed in order to be able to approach stronger T6 temper properties in the finished components. The T4 temper materials need only be aged at moderate temperatures for short periods of time to achieve near or full T6 temper properties. However, there are drawbacks to using an unstable T4 temper material in stamping operations inasmuch as the T4 temper is long-term unstable. Due to its instability, a T4 temper material used to form a component and then subsequently formed during additional process steps, such as cold working a driveshaft to provide splines, may develop cracks during the second forming operation, and as such, the component is defective and unusable.

Prior methods for overcoming the disadvantages of T4 temper alloys includes utilizing T5 or T6 temper alloys. T4 temper products are solution heat treated and naturally aged. T5

temper products cooled from an elevated temperature and artificial aged. T6 temper products are solution heat treated and artificially aged.

Although a T5 or T6 temper aluminum alloy is stable, it is difficult to draw or stamp such a material. Indeed, the material is generally too brittle to permit forming through such processes. U.S. Patent No. 5, 911, 844 to Benedyk, as referenced by the Examiner, heat treats T5 or T6 alloys to make them suitable for forming and is not directed to processing of T4 alloys or alleviating the difficulties of instability in T4 alloys.

In one embodiment, Applicants' have discovered that the instability effects resulting in cracking of splines formed in tubes of T4 alloys may be overcome by a method that includes the steps of providing a metallic tube comprised of an aluminum alloy selected from the group consisting of 2000, 6000, or 7000 series and having properties approaching or corresponding to T4 temper; heating said metallic tube to a temperature sufficient to remove the T4 temper; quenching said metallic tube; forming splines on said metallic tube; and artificially or naturally aging said metallic tube, as recited in Claim 1. In another embodiment, Applicants' have discovered that the instability effects resulting in cracking of splines formed in tubes of T4 alloys may be overcome by a method that includes the steps of forming a metallic tube of an aluminum alloy composed of 2XXX, 6XXX or 7XXX series; solution heat-treating said metallic tube; controlling time and/or temperature exposure conditions of said metallic tube so that a T4 temper is not achieved; forming splines on said metallic tube before said metallic tube has aged sufficiently to develop properties corresponding to a T4 temper; and aging said metallic tube, as recited in Claim 23.

Turning now to the Office Action, the Examiner rejected Claims 1, 4-23, and 26-39, under 35 U.S.C. §112, first paragraph, as allegedly failing to comply with the enablement

requirement. Claims 1-6, 8-10, 12-18, 21, 23-31, and 34-36 stand rejected, under 35 U.S.C. §103(a), as being allegedly unpatentable over U.S. Patent No. 5,911,844 to Benedyk ("Benedyk"). Claims 7, 19, 20, 22, 32, 33, and 37-39 stand rejected, under 35 U.S.C. §103(a), as being allegedly unpatentable over Benedyk in view of the publication ASM: Aluminum and Aluminum Alloys P. 305, 311, 319, and 462-463 ("ASM"). Claim 11 stands rejected under 35 U.S.C. §103 (a) as allegedly being unpatentable over Benedyk in view of U.S. Patent No. 6,452, 139 to Benoit et al. ("Benoit et al."). Claims 1-39 stand provisionally rejected on the ground of non-statutory obvious type double patenting as being unpatentable over Claims 1-22 of co-pending Application No. 10/772733. Applicants respectfully traverse for the following reasons.

Referring first the rejections under 35 U.S.C. §112, first paragraph, it is the Examiner's position that the claims allegedly contain subject matter, which was not described in such a way as to enable one skilled in the art to practice the invention. In response to the Examiner's comments and for the purposes of advancing prosecution, Applicants have amended Claims 1 and 23 to recite that the metallic tube is formed of an aluminum alloy composed of 2XXX, 6XXX or 7XXX series aluminum. Support for the amendments to Claims 1 and 23 are found in original dependent Claims 2 and 24. In light of the amendments to incorporate the subject matter of Claims 2 and 24 into their respective base claims, Applicants have cancelled Claims 2 and 24. Applicants have also amended Claims 3 and 25 to correspond with amended Claims 1 and 23. In light of the above described amendments, Applicants submit that the present §112, first paragraph, rejection has been overcome and respectfully request withdrawal thereof.

Turning to the rejections under 35 U.S.C. §103, to establish a prima facie case of obviousness three criteria must be met. First there must be some suggestion or motivation, either in the references themselves or the knowledge generally available to one of ordinary skill in the

art, to modify the reference or to combine reference teachings. *In re Rouffet*, 149 F.3d 1350, 1357, 47 USPQ2d 1543, 1457-58 (Fed. Cir. 1998). Second, there must be a reasonable expectation of success. *In re Merck & Co, Inc.*, 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986). Finally, the prior art reference (or references) combined must teach or suggest all of the claimed limitations. *In re Royka*, 490 F.2d 981, 180 USPQ 580 (CCPA 1974).

Applicants submit that the applied references fail to render Applicants' claimed invention unpatentable, since none of the applied prior art, either alone or in combination, teach or suggest a method of forming splines on a metallic tube comprised of an aluminum alloy selected from the group consisting of 2000, 6000, or 7000 series and having properties approaching or corresponding to T4 temper. Additionally, Applicants form splines on a previously formed structure, hence requiring two forming steps, whereas the applied references only disclose a single forming step. "To establish a prima facie case of obviousness of a claimed invention all the claimed limitations must be taught or suggested by the prior art". *In re Wilson*, 424 F.2d 1382, 1385, 165 USPQ 44, 496 (CCPA 1970).

Referring to the §103 rejection of Claims 1-22, Benedyk disclose a method for forming a metallic having T5 or T6 temper. More specifically, Benedyk discloses a method for increasing formability for drawing or stamping of hardened materials of T5 or T6 temper, which as discussed above, and as disclosed in column 1, lines 50-55 of the Benedyk reference, is typically too brittle to subject to draw and stamping operations. Benedyk disclose subjecting the T5 or T6 material to a temperature that softens the materials temper, hence removing the effects of the materials T5 of T6 heat treatment. Benedyk does not disclose T4 temper or methods for treating T4 temper materials to increase their stability. Therefore, since Benedyk does not disclose a method for forming splines on a metallic tube comprised of an aluminum alloy selected from the

group consisting of 2000, 6000, or 7000 series and having properties approaching or corresponding to T4 temper, Benedyk fail to teach or suggest each and every element of Applicants' method, as recited in amended Claim 1.

Turning to page 3 of the Office Action, the Examiner notes that Benedyk does not teach or suggest T4 type temper, but starts with stronger harder tempers of T5 or T6. The Examiner further alleges that it would have been obvious for one of ordinary skill in the art to apply the process of retrogressive heat treating applied to T5 or T6 tempers, as disclosed in Benedyk, to a T4 temper aluminum alloy, because Benedyk allegedly teaches a process that greatly improves formability. Applicants respectfully disagree.

Alloys in T5 and T6 tempers have limited suitability for forming and stamping due to their higher hardness than alloys in T4 temper. Hardness and ductility are substantially inversely proportional. T4 temper alloys have suitable ductility for forming and stamping operation, but may lack stability, wherein their instability may lead to cracking during multiple forming operations. Therefore, since Benedyk discloses a method for reducing hardness and increasing formability in T5 or T6 temper alloys, one having ordinary skill in the art would not find the process disclosed in Benedyk suitable for T4 alloys, since T4 alloys do not need further processing to provide increased ductility for forming and stamping operation. Contrary to the Benedyk disclosure, Applicants' process substantially reduces the effects of instability in T4 temper alloys.

It is further noted that Applicants' claimed method requires (1) forming a metal tube having properties approaching or corresponding to T4 temper; (2) heating the metallic tube to a temperature sufficient to remove the T4 temper; (3) quenching the metallic tube; (4) forming splines on said metallic tube; and (5) artificially or naturally aging said metallic tube. Benedyk

does not disclose forming splines on a previously formed tube, but instead discloses (1) heat treating a T5 or T6 temper material to a softened condition, (2) forming the material, and (3) heat treating the formed material to a strength and hardness at least equal to T5 or T6 temper. Therefore, Benedyk does not disclose forming splines on a previously formed (e.g. extruded or stamped) metallic tube, as required by amended Claim 1.

Therefore, since Benedyk is directed to T5 and T6 temper alloys, and fails to disclose T4 tempers or methods for overcoming long term instability in T4 tempers, or disclose forming of splines on a previously extruded or stamped product, Benedyk fails to teach or suggest each and every limitation of Applicants' claimed method. Applicants respectfully submit that the §103 rejections of Claims 1-22 have been obviated and respectfully request withdrawal thereof.

Referring to the §103 rejection of Claims 23-39, Applicants submit that Benedyk fails to render Claims 23-39 obvious for the same reason that Benedyk fails to render Claims 1-22 obvious. More specifically, Benedyk is directed to a method of increasing formability of T5 and T6 temper alloys, and therefore fails to teach or suggest Applicants' method for overcoming the difficulties with instability in T4 alloys. Benedyk also fails to teach or suggest forming splines on a previously extruded or stamped product.

Applicants further submit that Benedyk fail to teach or suggest controlling the time or temperature exposure conditions of a metallic tube following solution heat treatment to ensure that T4 temper is not established, as recited in Claim 23. Claim 23 recites a method for forming splines on a metallic tube includes the steps of: (a) forming a metallic tube of an aluminum alloy composed of 2XXX, 6XXX or 7XXX series; (b) solution heat-treating said metallic tube; (c) controlling time and/or temperature exposure conditions of said metallic tube so that a T4 temper

is not achieved; (d) forming splines on said metallic tube before said metallic tube has aged sufficiently to develop properties corresponding to a T4 temper; and (e) aging said metallic tube.

Benedyk only disclose heat treating a T5 or T6 alloy to soften the material; quenching the material; forming the article; and then heat treating the article to T5 or T6 temper. Benedyk does not disclose any further forming steps following heat treatment, and therefore fails to teach or suggest forming a metallic tube of an aluminum alloy; solution heat-treating said metallic tube; controlling time and/or temperature exposure conditions of said metallic tube so that a T4 temper is not achieved; forming splines on said metallic tube before said metallic tube has aged sufficiently to develop properties corresponding to a T4 temper; and then heat treating, as recited in Claim 23.

Referring to Page 4, paragraph 4 of the present Office Action, it is the Examiner's position that although Benedyk does not mention controlling time and/or temperature exposure conditions of said metallic tube so that a T4 temper is not achieved, the Examiner alleges that changes in concentration or temperature will not generally support the patentability of subject matter encompassed by the prior art unless there is evidence indicating such concentration or temperature is critical. Criticality of a variable may be proven when the variable is a results effective variable. Referring to paragraphs 40-45 of Applicants' disclosure, Applicants disclose that splines being cold formed on tubes of 6013 Aluminum Alloy being natural aged for two weeks exhibited cracking, wherein tubes of 6013 that were limited to room temperature for less than 12 hours could be cold formed without experiencing cracking. The natural aging time is critical to the materials ductility. Therefore, since the natural agent period is a results effective variable and Benedyk fails to teach or suggest controlling time and/or temperature exposure

conditions to ensure that a T4 temper is not achieved, the Benedyk reference fails to render Claim 23 and all claims depending therefrom non-obvious.

Claims 7, 19, 20, 22, 32, 33 and 37-39, stand rejected under 35 U.S.C. §103(a) as allegedly being unpatentable over Benedyk in view of pages 305, 311, 319 of the ASM. Benedyk fails to render Claims 7, 19, 20 and 22, for the same reason Benedyk fails to render Claims 1 and 23 unpatentable. More specifically, Benedyk fails to teach or suggest a method for forming splines on a metallic tube, comprising the steps of providing a metallic tube comprised of an aluminum alloy selected from the group consisting of 2000, 6000, or 7000 series and having properties approaching or corresponding to T4 temper, as recited in amended Claim 1. If an independent claim is non-obvious under 35 U.S.C. §103(a), then any claim depending therefrom is non-obvious. *In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988).

The ASM fails to fulfill the deficiencies of the primary reference, since the ASM also fails to teach or suggest a method of forming splines on a metallic tube including the step of providing a metallic tube comprised of an aluminum alloy selected from the group consisting of 2000, 6000, or 7000 series and having properties approaching or corresponding to T4 temper, as recited in amended Claim 1. The ASM publication also fails to teach or suggest a method of forming splines on a metallic tube including the step of controlling time and/or temperature exposure conditions of said metallic tube so that a T4 temper is not achieved, as recited in amended Claim 23.

Applicants submit that the ASM publication is far removed from Applicants' method. Page 305 of the ASM discloses forming and straightening following quenching processes, Page 311 of the ASM discloses precipitate hardening, and Page 319 discloses annealing, wherein none of the cited passages of the ASM disclose a method of forming splines on a metallic tube



including the step of providing a metallic tube comprised of an aluminum alloy selected from the group consisting of 2000, 6000, or 7000 series and having properties approaching or corresponding to T4 temper, as recited in amended Claim 1. Therefore, since the combination of Benedyk and the ASM fail to teach or suggest each and every limitation of Applicants' claimed method, it is respectfully requested that the present §103 rejection citing Benedyk and the ASM be withdrawn.

Turning to the §103 rejection of Claim 11, Benoit et al. also fail to fulfill the deficiencies of Benedyk, since Benoit et al. also fail to teach or suggest a method of forming splines on a metallic tube including the step of providing a metallic tube comprised of an aluminum alloy selected from the group consisting of 2000, 6000, or 7000 series and having properties approaching or corresponding to T4 temper, as recited in amended Claim 1. Benoit et al. disclose a process for joining high strength metal components by electromagnetic forming techniques and is far removed from the Applicants' invention. Applicants note that the Examiner is relying on the Benoit et al. reference solely to meet the limitation of rotating the metallic tube during heat treatment. There is no disclosure of Applicants' claimed method of forming splines on a metallic tube throughout the Benoit et al. reference. Therefore, since the combination of Benedyk and the Benoit et al. fail to teach or suggest each and every limitation of Applicants' claimed method, it is respectfully requested that the present §103 rejection citing Benoit et al. and the ASM be withdrawn.

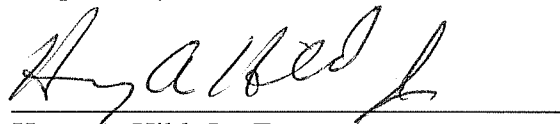
Claims 1-39 stand provisionally rejected on the ground of non-statutory obvious type double patenting as being unpatentable over Claims 1-22 of co-pending Application No. 10/772733. For the purposes of advancing prosecution, Applicants have attached a signed

PTO/SB/25 (09-04) terminal disclaimer form to obviate the provisional double patenting rejection over co-pending US Application No. 10/772733.

Accordingly, the Examiner is respectfully requested to reconsider the application, withdraw the rejections and issue an immediate a favorable action thereon. If upon review of the application, the Examiner is unable issue an immediate Notice of Allowance, the Examiner is respectfully requested to telephone the undersigned attorney with a view towards resolving any outstanding issues.

An early and favorable action is earnestly solicited.

Respectfully submitted,



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